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(54) **BROADBAND ANTENNA**

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H01Q 9/16 (2006.01)

(52) **U.S. Cl.**
USPC **343/791**; 343/749

(58) **Field of Classification Search**
USPC 343/722, 745, 749, 790, 791
See application file for complete search history.

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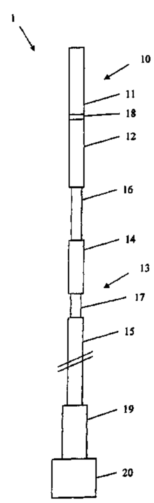
(57) **ABSTRACT**

An antenna comprises a monopole and a dipole. The dipole provides a first antenna element and a second antenna element, which provide a common longitudinal axis with the longitudinal axis of a monopole. The first antenna element of the dipole is connected to the second antenna element of the dipole and to the monopole. The monopole bears the dipole. The antenna further contains a decoupling element, which is disposed between the monopole and the dipole.

14 Claims, 9 Drawing Sheets



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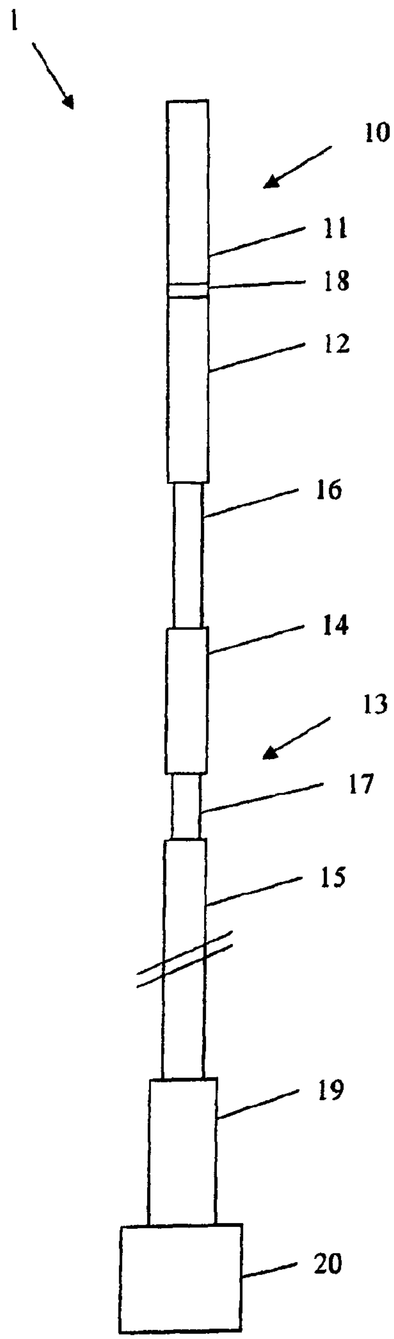

Fig. 1

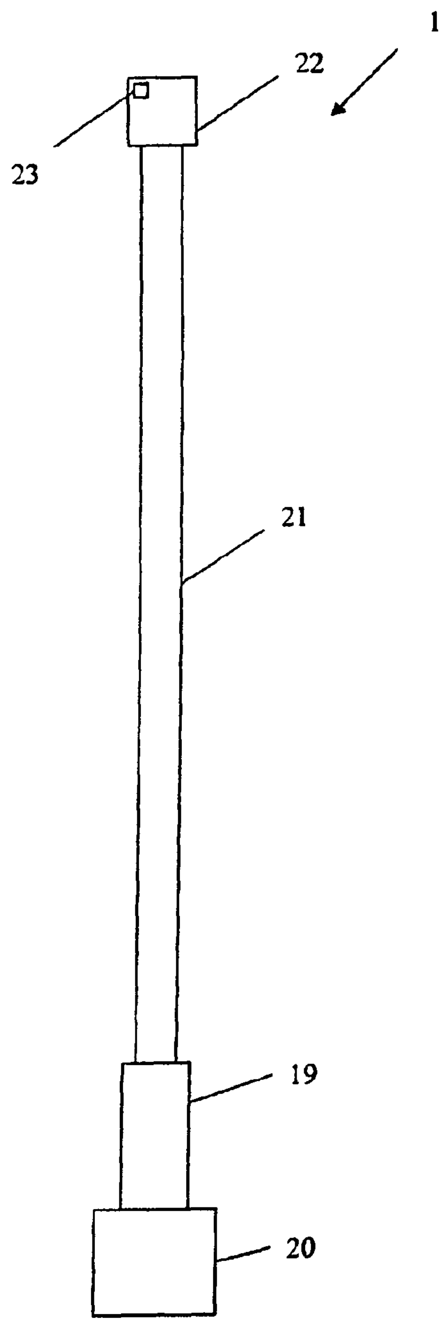

Fig. 2

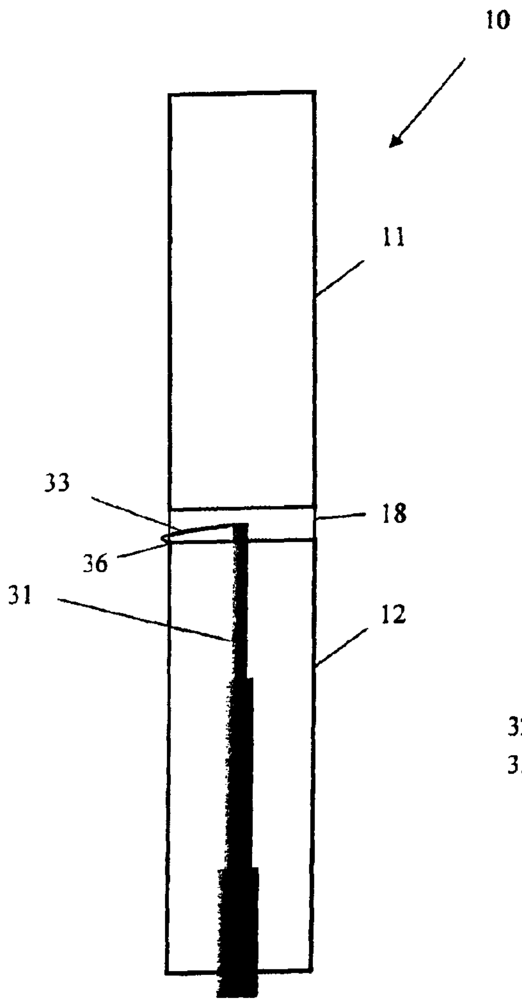

Fig. 3a

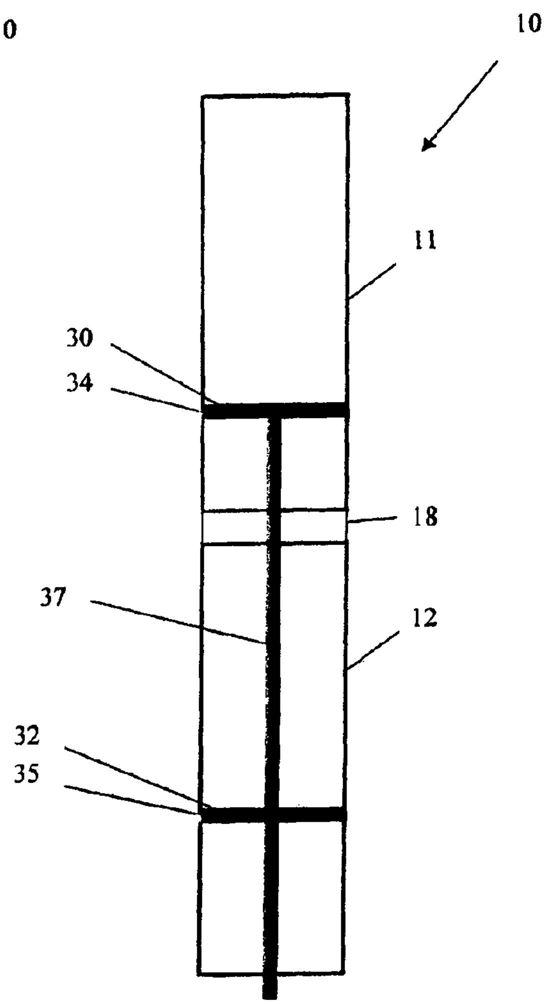

Fig. 3b

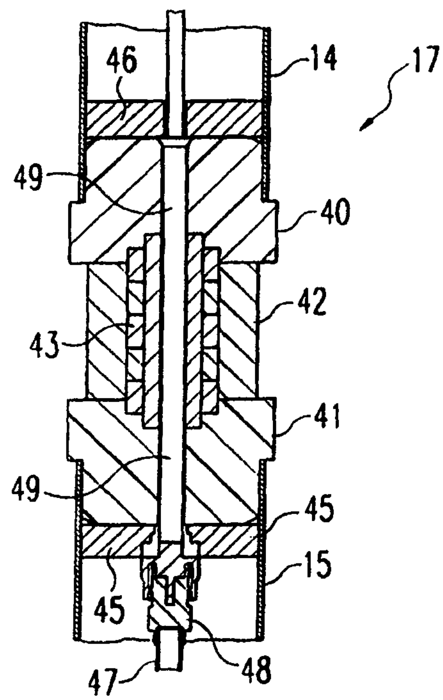

Fig. 4

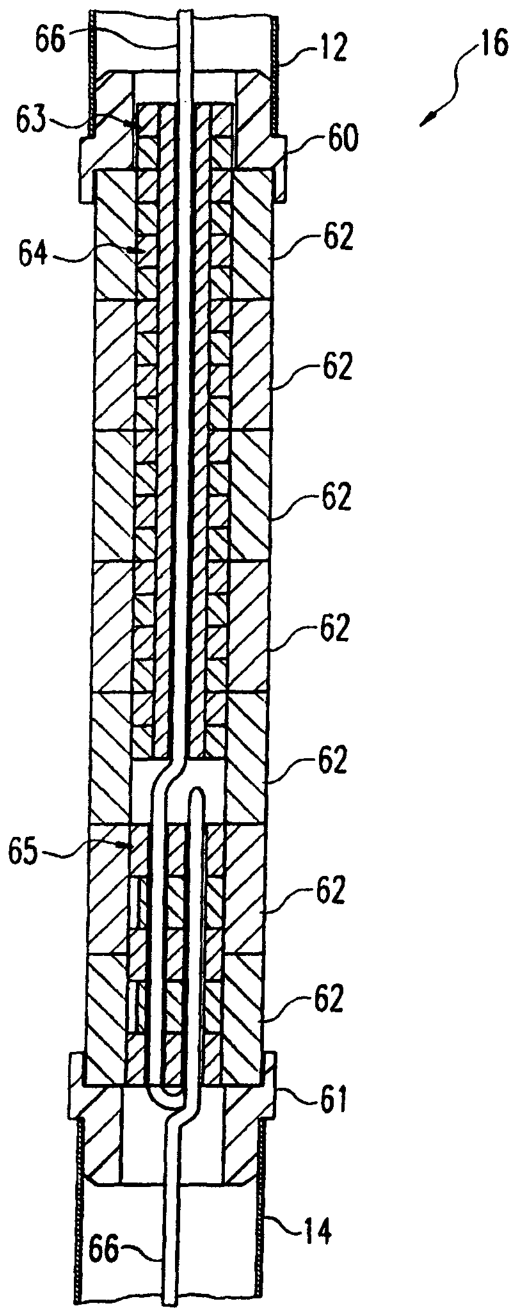

Fig. 5

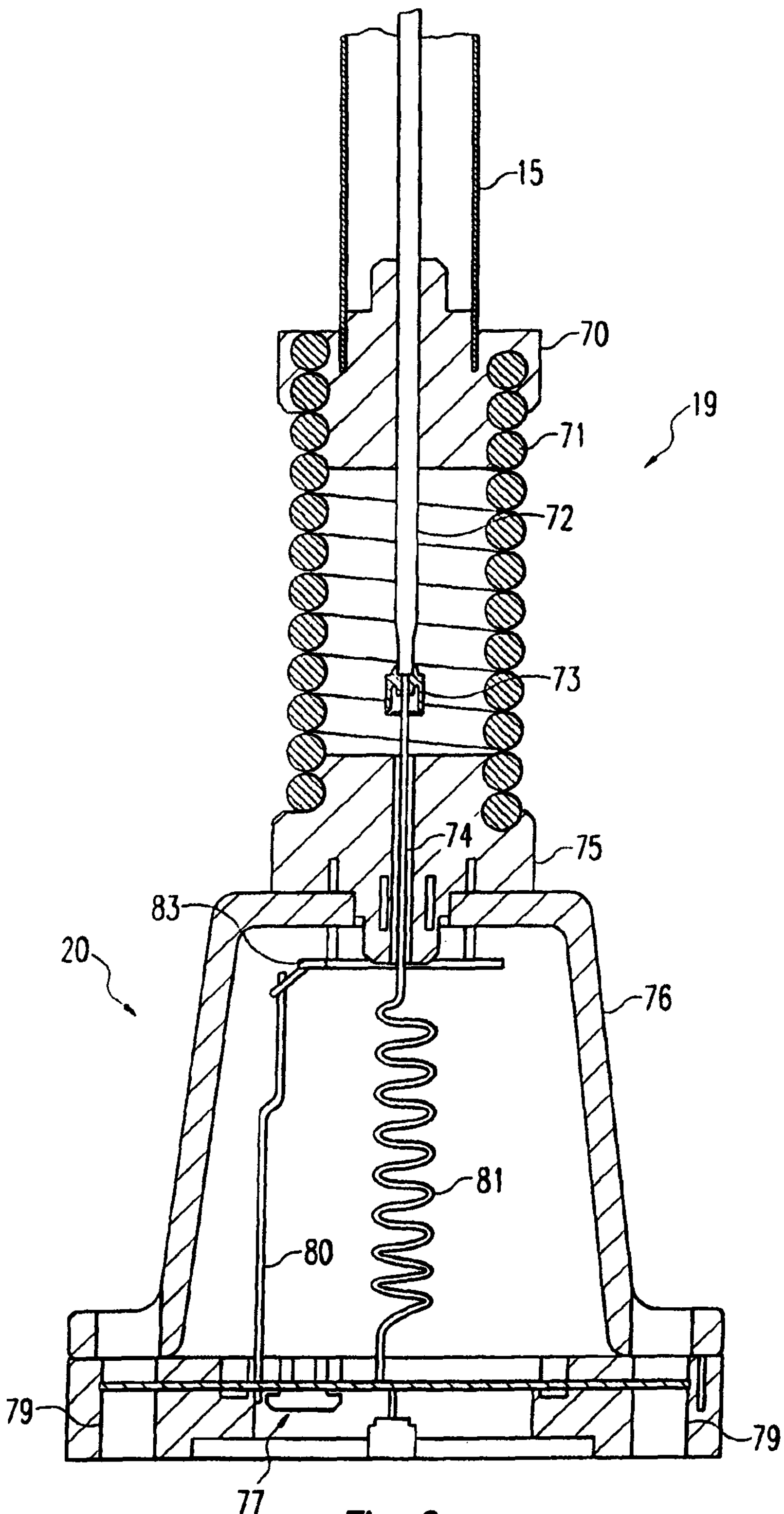

Fig. 6

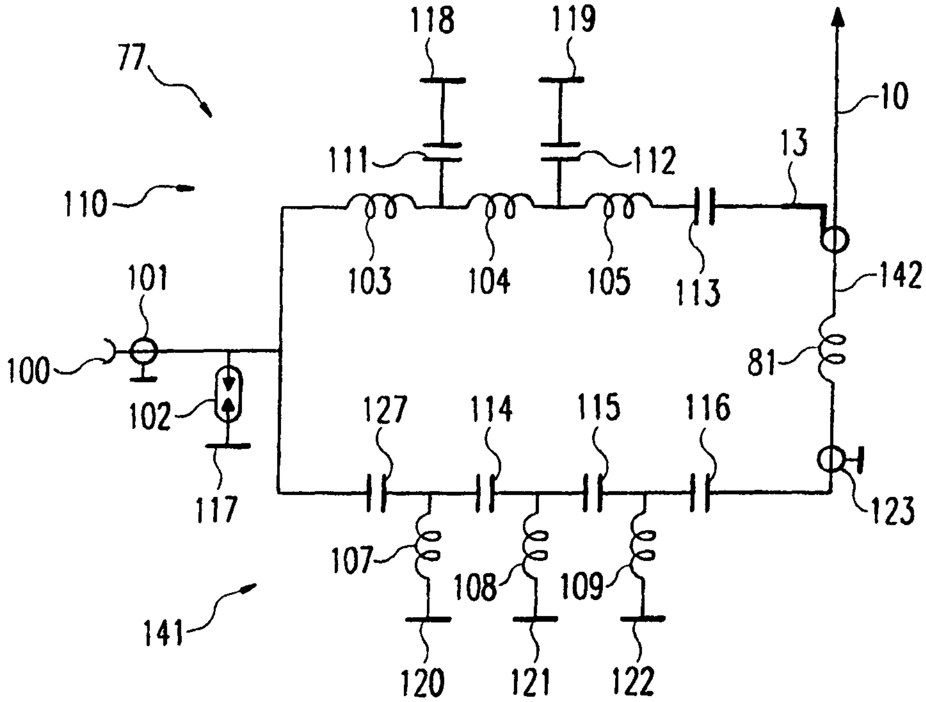

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Fig. 7

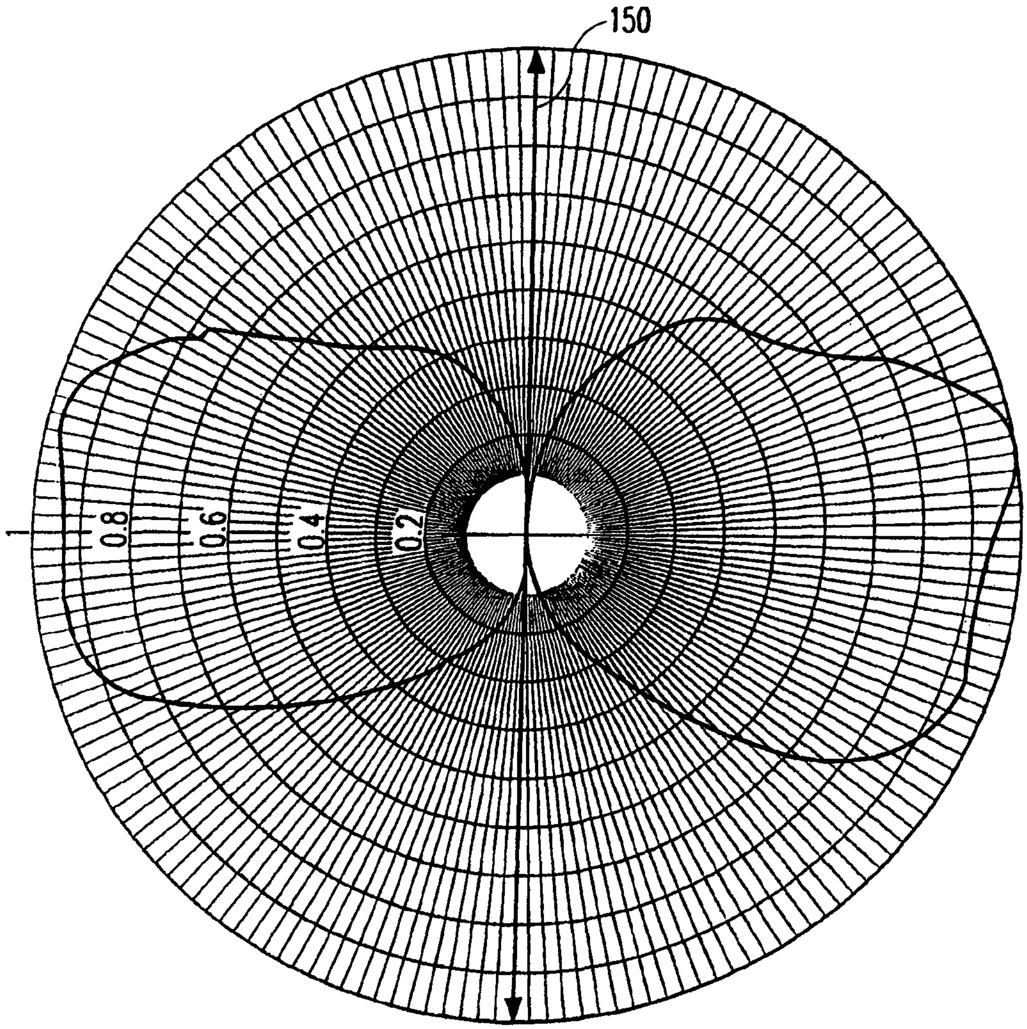

Fig. 8

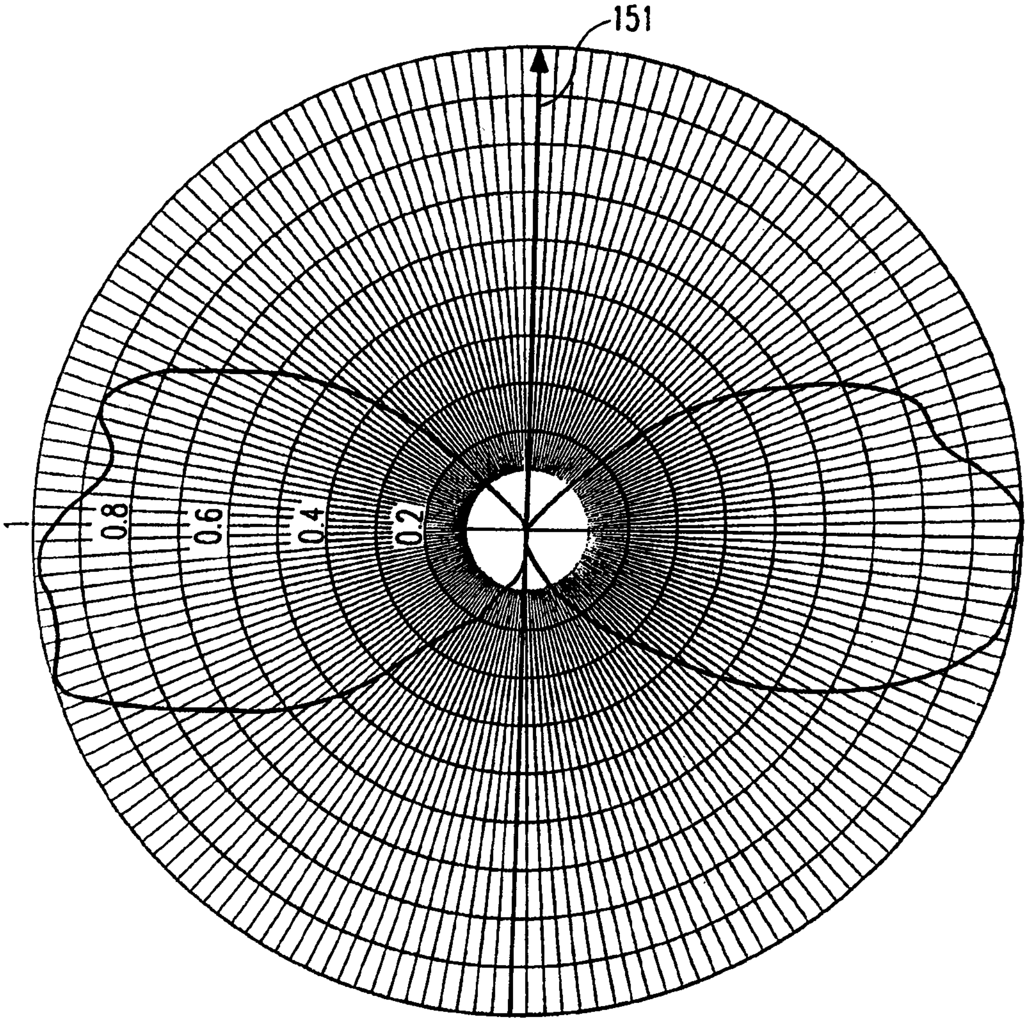

Fig. 9

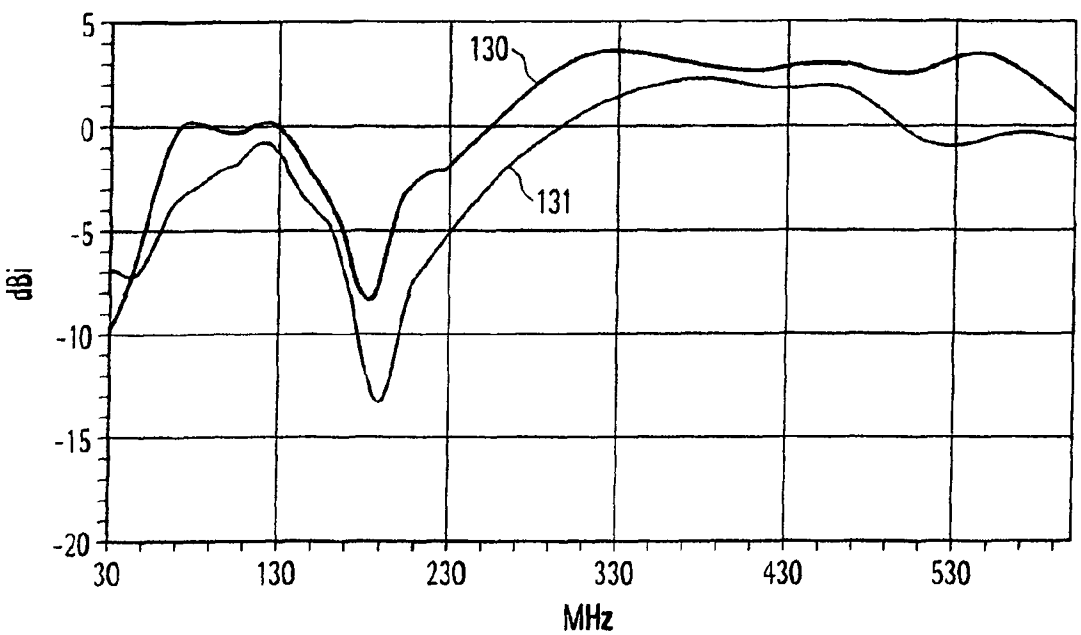

Fig. 10

BROADBAND ANTENNA

FIELD OF PRESENT DISCLOSURE

The invention relates to a broadband antenna with a monopole and a dipole.

BACKGROUND

Moreover, DE 102 35 222 A1 discloses a broadband antenna with a monopole and a dipole, which are used for different frequency ranges. However, this broadband antenna provides suboptimal directional properties and a suboptimal frequency response. Furthermore, the optical cross-section of this antenna covers a very large area, which excludes it from a large number of applications.

SUMMARY

Embodiments of the present invention are based on the object of providing a broadband antenna, which, with compact dimensions, especially a small width, provides a broadband frequency range.

The object is achieved by the antenna according to embodiments of the present invention with the features of claim **1**. Advantageous further developments form the subject matter of the dependent claims referring back to this claim.

An antenna according to embodiments of the present invention comprises a monopole and a dipole. The dipole provides a first antenna element and a second antenna element, which have a common longitudinal axis with the longitudinal axis of the monopole. The antenna further contains a decoupling element, which is arranged between the monopole and the dipole. Accordingly, an advantageous directional characteristic is achieved with a high antenna gain over a broad frequency range.

The first antenna element of the dipole is preferably connected to the second antenna element of the dipole and to the monopole. Accordingly, the monopole preferably bears the dipole.

The monopole is preferably designed at least partially in a tubular manner. The antenna preferably contains a line, which is disposed at least partially within the monopole. The line is preferably connected at a connection point to the dipole. Accordingly, a material-saving structure with advantageous transmission properties can be achieved.

A decoupling element preferably attenuates sheath waves. In this manner, interference is avoided, and the antenna gain is increased. The decoupling element advantageously contains a plurality of ferrite cores. The line is advantageously guided through at least a part of the ferrite cores. Thus, a high sheath waves attenuation can be obtained at a low production expenditure.

The antenna elements of the dipole are preferably designed at least partially in a tubular manner. The connection point of the line to the dipole is preferably disposed on the outside of the first antenna element. Accordingly, an interference-free coupling of the line and the antenna can be achieved.

An earth line is advantageously connected at a connection point to the inside of the first antenna element of the dipole. The earth line is preferably connected at a connection point to the inside of the second antenna element of the dipole. Accordingly, additional signal paths on the inside of the antenna element can be used.

A portion of the inside of the first antenna element limited by the connection point of its inside to the earth line and by its end facing towards the second antenna element advantageously forms a first inductance connected in parallel to the first antenna element of the dipole. A portion of the inside of the second antenna element limited by the connection point of its inside to the earth line and by its end facing towards the first antenna element advantageously forms a second inductance connected in series to the second antenna element of the dipole. The first inductance and the second inductance advantageously form a transformer, which implements an impedance matching. Accordingly, an impedance matching is possible without cost-intensive additional components.

The line preferably tapers in the direction towards its connection point with the dipole. The tapering advantageously achieves an impedance matching. Accordingly, a further impedance matching is possible with low manufacturing costs.

The monopole and the dipole are preferably connected via a diplexer to a common contact point. A simple manufacture with advantageous transmission properties can be achieved in this manner.

At least a part of the monopole is preferably formed as a fold-over element. This guarantees a good robustness of the antenna. The monopole advantageously comprises at least two antenna elements and a loading element. The loading element preferably implements an impedance matching. Accordingly, an optimal impedance matching is also achieved in the monopole with low manufacturing costs.

The loading element preferably comprises at least one ferrite core. The line is preferably guided through the ferrite core. An outer conductor of the line is preferably connected to the ends of the first and second antenna element of the monopole facing towards the loading element. Accordingly, only very low manufacturing costs are incurred for the impedance matching.

The monopole is advantageously disposed on a housing, which contains a filter. The filter preferably allocates signals of a high-frequency range to the dipole and signals of a low frequency range to the monopole. The filter is preferably connected to the line and to the monopole. Accordingly, optimal transmission properties are guaranteed with good stability of the antenna.

The line is advantageously formed at least partially as a stripline on a substrate. The substrate is preferably at least partially disposed in the interior of the antenna. Accordingly, a simple mechanical attachment of the inner conductor in the centre of the antenna is possible.

This summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This summary is not intended to identify key features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention are described by way of example below with reference to the drawings, in which an advantageous exemplary embodiment of the present invention is presented. The drawings are as follows:

FIG. **1** shows a first exemplary embodiment of the antenna according to aspects of the present invention;

FIG. **2** shows a detail view of the first exemplary embodiment of the antenna according to aspects of the present invention;

FIG. **3***a* shows a further detail view of the first exemplary embodiment of the antenna according to aspects of the present invention in the cross-section;

FIG. **3***b* shows a further detail view of the first exemplary embodiment of the antenna according to aspects of the present invention in the cross-section;

FIG. **4** shows a detail view of a second exemplary embodiment of the antenna according to aspects of the present invention in cross-section;

FIG. **5** shows a detail view of the second exemplary embodiment of the antenna according to aspects of the present invention in cross-section;

FIG. **6** shows a further detail view of the second exemplary embodiment of the antenna according to aspects of the present invention in cross-section;

FIG. **7** shows a circuit diagram of a matching network and filter of the second exemplary embodiment of the antenna according to aspects of the present invention;

FIG. **8** shows a first diagram of the directional effect of an exemplary antenna according to aspects of the present invention;

FIG. **9** shows a second diagram of the directional effect of an exemplary antenna according to aspects of the present invention; an

FIG. **10** shows antenna gain characteristics of an exemplary antenna according to aspects of the present invention.

DETAILED DESCRIPTION

Initially, the general structure and the general functioning of the antenna according to embodiments of the present invention is explained with reference to FIG. **1**. Following this, the structure and functioning of individual details of antennas according to embodiments of the present invention are illustrated on the basis of FIGS. **2-7**. Moreover, characteristic curves and directional characteristics of exemplary antennas according to embodiments of the present invention are explained with reference to FIGS. **8-10**. In some cases, the presentation and description of identical elements has not been repeated in similar drawings.

FIG. **1** shows a first exemplary embodiment of the antenna according to embodiments of the present invention. An antenna **1** comprises a monopole **13**, a decoupling element **16** and a dipole **10**. Furthermore, the antenna **1** contains an antenna base **20**. The monopole **13** is mounted on the base **20** and contains a fold-over element **19**, a first antenna element **15**, a second antenna element **14** and a loading element **17**. The fold-over element **19** is designed in this exemplary embodiment as a spiral spring. The antenna elements **14**, **15** are hollow tubes made of conducting material.

The fold-over element **19** is connected to the first antenna element **15**. The first antenna element **15** is further connected to the loading element **17**. Moreover, the latter is connected to the second antenna element **14**.

The dipole **10** contains a first antenna element **12**, a spacer **18** and a second antenna element **11**. In this context, the two antenna elements **11**, **12** are connected by the spacer **18**. The second antenna element **14** of the monopole **13** is connected to the decoupling element **16**. The latter is connected to the first antenna element **12** of the dipole **10**.

The monopole **13** and the dipole **10** form respectively independent partial antennas for the different frequency ranges. The separation of the frequency ranges in this context is implemented by means of a filter, especially a diplex filter, which is preferably disposed in the base **20**. This filter will be described in greater detail with reference to FIG. **7**. The signal supply of the monopole **13** is provided by direct connection to the filter. The signal supply of the dipole is implemented by means of a line extending in the interior of the antenna **1**. This will be described in greater detail with reference to FIGS. **3**, **4**, **5** and **6**.

The loading element **17** of the monopole **13** is used in this context for impedance matching. The decoupling element **16** between the dipole and the monopole is used for the attenuation of sheath waves.

Accordingly, the dipole is designed for a high-frequency range from 50 MHz to 2000 MHz, preferably from 150 MHz to 1000 MHz, by particular preference from 200 MHz-600 MHz. The monopole is designed for a low frequency range from 0.1 MHz to 400 MHz, preferably from 10 MHz to 250 MHz, by particular preference from 30 MHz-160 MHz.

The monopole provides a length from 700 mm to 2000 mm, preferably from 1000 mm to 1800 mm, by particular preference of 1600 mm. The dipole provides a length from 200 mm to 600 mm, preferably from 350 mm to 500 mm, by particular preference of 465 mm. The antenna elements of the dipole are largely identical in length. Accordingly, the antenna has a largely uniform diameter from 10 mm to 100 mm, preferably from 20 mm to 40 mm, by particular preference of 28 mm.

FIG. **2** shows a detail of the first exemplary embodiment of the antenna according to embodiments of the present invention. The antenna **1** in this context is at least partially enclosed by a protective sleeve **21**. This protective sleeve **21** provides a spacing distance from the components described with reference to FIG. **1**. The spacing distance is preferably foam filled in order to increase the mechanical stability. The protective sleeve in this exemplary embodiment is designed as a radome. Furthermore, the upper end of the antenna **1** is provided with a cap **22**. The cap **22** is optionally connected to an eye **23**, which is used for fastening down the antenna **1** in rough terrain.

In FIGS. **3***a* and FIG. **3***b*, further detail views of the first exemplary embodiment of the antenna according to embodiments of the present invention are illustrated. The dipole **10** comprises the first antenna element **12**, the second antenna element **11** and the spacer **18**. The antenna elements **11**, **12** in this context are designed as hollow tubes. The tubes comprise a conducting material. A printed-circuit board is disposed in the interior of the tubes and is held in position by their internal diameter. FIG. **3***a* shows the front side of the printed-circuit board. FIG. **3***b* shows the rear side of the printed circuit board.

A stripline **31** extends in the interior of the antenna elements **11**, **12** on the front side of the printed-circuit board and routes signals from the dipole **10** or routes signals to the dipole **10**. The line **31** is connected to the inner conductor of a coaxial line as a supply line. By means of a conducting connection **33**, the line **31** is connected at a contact point **36** to the outside of the upper edge of the first antenna element **12**.

A line **37** extends on the rear side of the printed circuit board. It is connected to the sheath of the coaxial line as a supply line. The line **37** is connected by means of a conducting connection **32** at a contact point **35** to the inside of the first antenna element **12**. The contact point **35** is disposed between the ends of the first antenna element **12**. Furthermore, the line **37** is connected by means of a conducting connection **30** at a contact point **34** to the inside of the second antenna element. The contact point **34** is disposed between the ends of the second antenna element **11**.

The functioning of the dipole **10** is presented below with reference to a transmitted signal. However, the functioning is reciprocal for a received signal. The signal is transmitted via the lines **31** and **37** to the dipole **10**. Via the conducting connection **33**, it reaches the outside of the first antenna element **12** and is broadcast from the latter.

Furthermore, via the conducting connection **32** at the contact point **35**, the signal reaches the inside of the first antenna coupler **12**. However, the inside of the antenna element **12** cannot transmit the signal. The signal runs on the internal surface of the antenna element **12** parallel to the line **31** to the upper edge of the antenna element **12**. From there, it reaches the outer surface of the antenna element **12** and is similarly broadcast. The short-circuit by means of the conducting connection **32** acts as a parallel configuration of an inductance, that is to say, an inductance is connected in parallel to the line **37** in the equivalent circuit diagram. Furthermore, the signal runs via the line **37** and the conducting connection **30** at the contact point **34** to the inside of the second antenna element **11** of the dipole **10**. From there, it passes via the inside of the second antenna element **11** to its lower edge. From there, it passes to the surface of the second antenna element **11** and is broadcast. There is no direct connection of the line **37** to the surface of the second antenna element **11**. In the equivalent circuit diagram, the short-circuit through the conducting connection **30** acts as an inductance connected in series to the line **37**. This additional configuration with parallel and serial inductances forms a transformer and is used for matching the impedance.

The line **31** in this exemplary embodiment is not constant in width. Accordingly, the line **31** provides a stepped width. In the lower region, it provides a large width. In the middle region, it provides a medium width. In the upper region, it provides a narrow width. This measure further supports the matching of the impedance of the line **31** to the impedance of the dipole **10**.

As an alternative, the line **31** can be designed as a coaxial line. However, especially with a small cross-section, high manufacturing costs are incurred in order to fix the line **31** centrally. The connections between the portions of different cross-sections of the line **31** also require increased manufacturing costs. These problems are resolved by the embodiment of the line **31** as a stripline on a printed-circuit board.

FIG. **4** shows a detail view of a second exemplary embodiment of the antenna according to embodiments of the present invention. The loading element **17** is connected to the first antenna element **15** and to the second antenna element **14** of the monopole **13**. Here, it contains the two connecting washers **45**, **46**, two spacers **40**, **41**, a contact **48**, a coaxial line **49** and a plurality of ferrite cores **42**, **43**, **44**.

A line **47** extending within the interior of the monopole **13** is connected via the contact **48** through a borehole in the connecting washer **45** to the inner conductor of the coaxial line **49**. The sheath line of the coaxial line **49** is connected by means of the connecting washer **45** to the first antenna element **15** of the monopole **13**. The coaxial line **49** is guided through a plurality of ferrite cores **42**, **43**, **44**, some of which are disposed one inside the other. In this context, the sheath line of the coaxial line **49** is still connected by means of the connecting washer **46** to the second antenna element **14** of the monopole. The inner conductor of the coaxial line **49** is guided through a borehole in the connecting washer **46**. The ferrite cores **42**, **43**, **44** here are held in position by the spacers **40**, **41**. The latter are manufactured from a non-conducting material, such as fibre-glass reinforced synthetic material. A conducting connection of the two antenna elements **14**, **15** of the monopole **13** is provided only via the sheath line of the coaxial line **49**.

The guiding of the coaxial line **49** through the ferrite cores **42**, **43**, **44** leads to an inductance load per unit length of the coaxial line **49**. In the equivalent circuit diagram, this corresponds to the circuit of an inductance, which is connected in parallel to an ohmic resistor, in series with the line **49**. This inductance load per unit length supports the matching of the impudence of the line **49**.

FIG. **5** shows a further detail view of the second exemplary embodiment of the antenna according to embodiments of the present invention. The decoupling element **16** contains a line **66**, a plurality of ferrite cores **62**-**65** and two spacers **60**, **61**. The line **66** is a coaxial line. The ferrite cores **65** each provide two through-passages. They are arranged in such a manner, that they are each disposed with one through-passage above the other. The line **66** is guided through these through-passages from the bottom to the top. The second through-passages of a first part of the ferrite cores **65** are also disposed one above the other. The line **66** is guided through these through-passages from the top to the bottom. The second through-passages of a second part of the ferrite cores **65** are also disposed in each case one above the other, however, not above the through-passages of the first part of the ferrite cores. The line **66** is finally guided from the bottom to the top through these through-passages.

Some of the ferrite cores **62**-**65** are arranged one inside the other. Accordingly, the ferrite cores **63**, **64**, **65** are arranged within the ferrite cores **62**. Furthermore, the ferrite cores **64** are arranged within the ferrite cores **63**. The line **66** passes through the ferrite cores **65** and **64** and therefore also through the ferrite cores **63** and **62**.

The spacers **60**, **61** connect the decoupling element **16** in a non-conducting manner to the second antenna element **14** of the monopole **13** and to the first antenna element **12** of the dipole **10**. The passage of the line **66** through the ferrite cores **62**-**65** brings about a strong attenuation of sheath waves, which are present on the shielding sheath of the line **66**. Accordingly, the monopole **13** and the dipole **10** are decoupled from one another. This prevents interference and accordingly stabilises the radiation performance.

FIG. **6** shows a further detail view of the second exemplary embodiment of the antenna according to embodiments of the present invention. As shown in principle with reference to FIG. **1**, the monopole **13** contains a first antenna element **15** and a fold-over element **19**. The fold-over element **19** provides a first housing element **75**, a second housing element **70** and a spring **71**. The spring **71** connects the housing elements **70**, **75** to one another in a conducting manner. The second housing element **70** is connected in a conducting manner to the first antenna element **15** of the monopole. Both the housing elements **70**, **75** and also the spring **71** form a part of the monopole **13**.

A line **72** is arranged within the antenna element **15**, inside the housing element **70** and inside the spring **71**. An optional contact **73** is arranged inside the spring **71**. A line **74** is arranged inside the housing element **75** and inside the spring **71**. The line **72** is connected by means of the contact **73** to the line **74**. The lines **72**, **74** here provide a flexibility at least at the level of the flexibility of the spring **71**.

The antenna base **20** provides a housing **76**, a filter **77**, a high-frequency signal contact **82**, a first signal line **80**, a second signal line **81** and several holding boreholes **79**. The base **20** can be attached to a surface by means of the holding boreholes **79**. The housing **76** of the base **20** is connected in a non-conducting manner to the housing element **75** of the fold-over element **19**. The filter **77** is mounted rigidly inside the housing **76**. The high-frequency signal contact **82** is connected to the filter **77**. The signal lines **80**, **81** are also connected to the filter **77**. The first signal line **80** is connected at a contact point **83** to the first housing element **75**. The second signal line **81** is connected to the line **74**. The second signal line **81** here comprises a wire wound to form a coil.

The function is presented below with reference to an exemplary signal to be transmitted. A signal to be transmitted is broadcast via the high-frequency signal contact **82** to the filter **77**. The filter **77** separates the signal to be transmitted into a high-frequency partial signal and into a low-frequency partial signal. The low-frequency partial signal is transmitted via the first signal line **80** to the contact point **83** through a borehole in the housing **76** of the filter **77** to the housing element **75**. A conducting connection to the housing **76** of the base **20** is not provided in this context. The housing element **75** is a part of the monopole **13**. From the housing element **75**, the signal is transmitted to the spring **71**, the second housing element **70** and the rest of the monopole **13**, from where it is broadcast.

The high-frequency partial signal is transmitted by means of the second signal line **81** to the line **74**, which is guided through a borehole in the housing element **75**. This line **74** communicates the signal to the dipole **10**, which broadcasts the signal.

FIG. **7** shows a circuit diagram of an exemplary embodiment of the matching network and filter of the antenna according to embodiments of the present invention. The filter **77** is presented in greater detail here. The filter **77** is preferably a diplexer circuit. In this exemplary embodiment also, the function is presented with reference to a signal to be transmitted. The function in reception mode is reciprocal. A signal to be transmitted is fed in via a signal contact **100**. A shielding sheath of a line, by means of which the signal is connected to the signal contact **100**, is connected to the earth contact **101**. Overloads, especially through lightning strike, are deflected via a surge protector **102** to the earth contact **117**. The signal is now divided between two signal paths **140**, **141**.

The first signal path **140** comprises a series circuit of several inductances **103**, **104**, **105** and a coupling capacitor **113**, and a parallel circuit of several capacitors **111**, **112** to the earth contacts **118**, **119**. This branch of the filter circuit strongly attenuates high-frequencies, while it attenuates low frequencies only slightly. The first signal path **140** is connected to the monopole **13**.

The second signal path **141** comprises a series circuit of several capacitors **114**, **115**, **127** and a coupling capacitor **116**, and a parallel circuit of several inductances **107**, **108**, **109** to the earth contacts **120**, **121**, **122**. This branch of the filter circuit strongly attenuates low frequencies, while it attenuates high frequencies only slightly. The second signal path **141** is connected via a shielded line to the choke coil **81**. In this context, the shield is connected to the earth contact **123**. The connection to the dipole **10** is implemented by means of the line **142**. The line **142** here extends through the monopole **13**.

FIG. **8** shows a first diagram of the directional effect of an antenna according to embodiments of the present invention in the second exemplary embodiment. The horizontal directional characteristic is presented with a frequency of 250 MHz. That is to say, the antenna is disposed in the centre of the illustration and is orientated in the direction of the axis **150**. The strong directional effect in the horizontal direction is clearly recognisable.

FIG. **9** shows a second diagram of the directional effect of an antenna according to embodiments of the present invention in the second exemplary embodiment. The horizontal directional characteristic is presented with a frequency of 550 MHz. The antenna is disposed in the centre of the illustration and is orientated in the direction towards the axis **151**. The strong directional effect in the horizontal direction is clearly recognisable. This is more strongly pronounced than at 250 MHz as illustrated in FIG. **8**.

FIG. **10** shows antenna-gain characteristics of an exemplary antenna according to embodiments of the present invention. The antenna gain of an antenna according to embodiments of the present invention is shown with a first characteristic 130, and the antenna gain of an antenna corresponding to the prior art with a second characteristic 131. It is evident that the antenna according to embodiments of the present invention achieves a higher antenna gain in almost the entire frequency range considered than the antenna according to DE 102 35 222 A1 associated with the prior art.

Embodiments of the present invention are not restricted to the exemplary embodiment presented. A use of different dimensions of the antenna and its individual elements is also conceivable, as is the use of alternative elements for impedance matching. An expansion to a broader frequency range is also conceivable. All of the features described above or illustrated in the drawings can be combined with one another advantageously within the framework of embodiments of the present invention as required.

The invention claimed is:

1. An antenna comprising:

a monopole comprising at least two antenna elements and a loading element, the loading element configured to implement an impedance matching;

a dipole comprising a first antenna element and a second antenna element, which provide a common longitudinal axis with the longitudinal axis of the monopole; and

a decoupling element disposed between the monopole and the dipole.

2. The antenna according to claim **1**, wherein the first antenna element of the dipole is connected to the second antenna element of the dipole and to the monopole and the monopole bears the dipole.

3. The antenna according to claim **1**, wherein

the monopole is designed at least partially in a tubular form,

the antenna contains a line,

the line is disposed at least partially within the monopole, and

the line is connected at a connection point to the dipole.

4. The antenna according to claim **3**, wherein the decoupling element attenuates sheath waves.

5. The antenna according to claim **3**, wherein

the decoupling element contains a plurality of ferrite cores and

the line is guided through at least a part of the ferrite cores.

6. The antenna according to claim **3**, wherein

the antenna element of the dipole is designed at least partially in a tubular manner and

the connection point of the line to the dipole is disposed on the outside of the first antenna element.

7. The antenna according to claim **3**, wherein

an earth line is connected at a connection point to the inside of the first antenna element of the dipole and

the earth line is connected at a connection point to the inside of the second antenna element of the dipole.

8. The antenna according to claim **7**, wherein

a portion of the inside of the first antenna element limited by the connection point of its inside with the earth line and by its end facing towards the second antenna element forms a first inductance connected in parallel to the first antenna element of the dipole,

a portion of the inside of the second antenna element limited by the connection point of its inside with the earth line and by its end facing towards the first antenna element forms a second inductance connected in series to the second antenna element of the dipole, the first inductance and the second inductance form a transformer, and

the transformer implements an impedance matching.

9. The antenna according to claim **3**, wherein

the line tapers in the direction towards its connection point with the dipole and that the tapering achieves an impedance matching.

10. The antenna according to claim **3**, wherein

the monopole is disposed on the housing,

the housing contains a filter,

the filter allocates signals of a high-frequency range to the dipole and signals of a low frequency range to the monopole, and

the filter is connected to the line and the monopole.

11. The antenna according to claim **3**, wherein

the line is formed at least partially as a strip line on a substrate and

the substrate is disposed at least partially in the interior of the antenna.

12. The antenna according to claim **1**, wherein the monopole and the dipole are connected via a diplexer to a common contact point.

13. The antenna according to claim **1**, wherein at least one part of the monopole is formed as a fold-over element.

14. The antenna according to claim **1**, wherein

the loading element comprises at least one ferrite core,

the line is guided through the ferrite core, and

an outer conductor of the line is connected to the ends of the first and second antenna elements of the monopole facing towards the loading element.

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